Elastic Properties and Young Modulus for some Materials

Young Modulus (Tensile Modulus) for common materials - steel, glass, wood and more ..

To describe elastic properties of linear objects like wires, rods, or columns which are stretched or compressed, a convenient parameter is the ratio of the stress to the strain, a parameter called the "*Young's modulus*" or "*Modulus of Elasticity*" of the material. Young's modulus can be used to predict the elongation or compression of an object as long as the stress is less than the yield strength of the material.

Material	Young's Modulus (Modulus of Elasticity) - *E* -		Ultimate Tensile Strength - S_u -	Yield Strength - S_y -
	(10^6 psi)	*(10^9 N/m², GPa)*	*(10^6 N/m², MPa)*	*(10^6 N/m², MPa)*
ABS plastics		2.3	40	
Acrylic		3.2	70	
Aluminum	10.0	69	110	95
Antimony	11.3			
Beryllium	42			
Bismuth	4.6			
Bone		9	170 (compression)	
Boron				3100
Brasses		100 - 125	250	
Bronzes		100 - 125		
Cadmium	4.6			
Carbon Fiber Reinforced Plastic		150		
Cast Iron 4.5% C, ASTM A-48			170	
Chromium	36			
Cobalt	30			
Concrete, High Strength (compression)		30	40 (compression)	
Copper	17		220	70
Diamond		1,050 - 1,200		

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Douglas fir Wood		13	50 (compression)	
Glass		50 - 90	50 (compression)	
Gold	10.8			
Iridium	75			
Iron	28.5			
Lead	2.0			
Magnesium	6.4	45		
Manganese	23			
Marble			15	
Mercury				
Molybdenum	40			
Nickel	31			
Niobium (Columbium)	15			
Nylon		2 - 4	75	45
Oak Wood (along grain)		11		
Osmium	80			
Pine Wood			40	
Platinum	21.3			
Plutonium	14			
Polycarbonate		2.6	70	
Polyethylene HDPE		0.8	15	
Polyethylene Terephthalate PET		2 - 2.7	55	
Polyimide		2.5	85	
Polypropylene		1.5 - 2	40	
Polystyrene		3 - 3.5	40	
Potassium				
Rhodium	42			
Rubber		0.01 - 0.1		
Selenium	8.4			
Silicon	16			
Silicon Carbide		450		3440
Silver	10.5			
Sodium				
Stainless Steel, AISI 302			860	502
Steel, Structural ASTM-A36		200	400	250

Steel, High Strength Alloy ASTM A-514			760	690
Tantalum	27			
Thorium	8.5			
Titanium	16			
Titanium Alloy		105 - 120	900	730
Tungsten		400 - 410		
Tungsten Carbide		450 - 650		
Uranium	24			
Vanadium	19			
Wrought Iron		190 - 210		
Zinc	12			

- *1 N/m^2 = 1x10^{-6} N/mm^2 = 1 Pa = 1.4504x10^{-4} psi*
- *1 psi (lb/in^2) = 144 psf (lb$_f$/ft^2) = 6,894.8 Pa (N/m^2) = 6.895x10^{-3} N/mm^2*

Note! Use the pressure unit converter on this page to switch the values to other units.

Strain

Strain can be expressed as

strain = dL / L (1)

where

strain = (m/m) (in/in)

dL = elongation or compression (offset) of the object (m) (in)

L = length of the object (m) (in)

Stress

Stress can be expressed as

stress = F / A (2)

where

stress = (N/m^2) (lb/in^2, psi)

F = force (N) (lb)

A = area of object (m^2) (in^2)

Young's Modulus (Tensile Modulus)

Young's modulus or Tensile modulus can be expressed as

E = stress / strain = (F / A) / (dL / L) (3)

where

E = Young's modulus (N/m^2) (lb/in^2, psi)

Elasticity

Elasticity is a property of an object or material which will restore it to its original shape after distortion.

A spring is an example of an elastic object - when stretched, it exerts a restoring force which tends to bring it back to its original length. This restoring force is in general proportional to the stretch described by Hooke's Law.

Hooke's Law

One of the properties of elasticity is that it takes about twice as much force to stretch a spring twice as far. That linear dependence of displacement upon stretching force is called Hooke's law which can be expressed as

$F_s = -k\, dL$ (4)

where

F_s = *force in the spring (N)*

k = *spring constant (N/m)*

dL = *elongation of the spring (m)*

Yield strength

Yield strength, or the yield point, is defined in engineering as the amount of strain that a material can undergo before moving from elastic deformation into plastic deformation.

Ultimate Tensile Strength

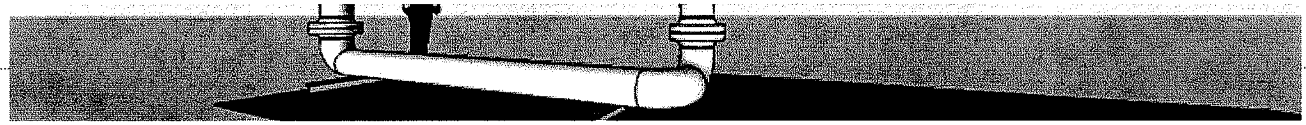
The Ultimate Tensile Strength - *UTS* - of a material is the limit stress at which the material actually breaks, with sudden release of the stored elastic energy.

Related Topics

- Material Properties Material properties - density, heat capacity, viscosity and more - for gases, fluids and solids
- Mechanics Kinematics, forces, vectors, motion, momentum, energy and the dynamics of objects

Related Documents

- Speed of Sound Formulas Calculation formulas for velocity of sound in gases, fluids or solids
- Young Modulus of Elasticity for Metals and Alloys Elastic properties and Youngs modulus for common metals and alloys as cast iron, carbon steel and more
- Thermoplastics - Physical Properties Physical properties of some common thermoplastics - ABS, PVC, CPVC, PE, PEX, PB and PVDF
- Stress in Bolts Calculating the stressed area in UN and UNR bolts
- Modulus of Rigidity Shear Modulus or Modulus of Rigidity is the coefficient of elasticity for a shearing or torsion force
- Stress in Thick-Walled Tubes or Cylinders Radial and tangential stress in thick-walled tubes or cylinders with closed ends - internal and external pressure
- Stress, Strain and Young's Modulus Stress is force per area - strain is deformation of a solid due to stress
- Bolt Stretching Bolt stretch according Hooke's Law
- Poissons ratio When a material is stretched in one direction it tends to get thinner in the other two directions
- Engineering Materials Comparing some typical properties of common engineering materials like steel, plastics, ceramics and composites



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